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VANE PUMP
[Been ponpu]

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Claims

1. A vane pump that has rotor 3 with vanes 2, which are provided at prescribed intervals in the circumferential direction in such a manner that they can slide in the radial direction inside grooves 1, and cam ring 5 with inner circumferential surface 4, that surrounds said rotor 3 at a prescribed eccentricity from it while in contact with tip parts 11 of aforementioned vanes 2; wherein, vane pump P is characterized in that vane biasing body 23, which has multiple elastic protrusions 25 to be placed in contact with base parts 10 of aforementioned respective vanes 2 elastically at its peripheral part, is attached at least to one side surface of aforementioned rotor 3 in order to allow vane pump P to be operated while aforementioned respective vanes 2 remain in contact with inner circumferential surface 4 of cam ring 5.

2. The vane pump described under Claim 1, characterized in that aforementioned elastic protrusions 25 protrude by the length that matches the length direction of vanes 2, and that they have a corrugated cross-section with at least two peaks 26.

Detailed explanation of the invention

The present invention pertains to a vane pump. In particular, it pertains to an improvement of a vane pump in which the contact state between vanes and a cam ring is maintained when in operation in order to prevent backflow of a hydraulic oil through the contact part.

A nonequilibrium vane pump will be explained as a conventional vane pump of this kind. In general, vane pump P was configured with rotor 3 with vanes 2 that were provided at prescribed intervals in the circumferential direction in such a manner that they could slide in the radial direction inside grooves 1 and cam ring 5 with inner circumferential surface 4 that surrounded said rotor 3 at a prescribed eccentricity from it as shown in Figure 1. However, because aforementioned respective vanes 2 were always biased in the radial direction of rotor 3 by springs 6 that were installed inside respective grooves

3, respective vanes 2 were pressed against inner circumferential surface 4 of cam ring 5 so as to remain in contact with cam ring 5 at all times in spite of the centrifugal force generated by the rotations of rotor 3 in order to prevent backflow of hydraulic oil effectively when vane pump P was in operation. In addition, as another means for preventing backflow of a hydraulic oil, the one shown in Figure 2 and Figure 3 is also available; wherein, annular concave parts 7 are formed on both side surfaces of rotor 3, ring bodies 8 are loosely fitted into said concave parts 7 concentrically to round inner circumferential surface 4 of cam ring 5, and vanes 2 are installed in such a manner that their base parts 10 are guided while sliding on outer circumference guide surfaces 9 of said ring bodies 8, whereby tip parts 11 of vanes 2 slide in and out of grooves 1 of rotor 3 so as to remain in contact with inner circumferential surface 4 of cam ring 5 at all times.

However, said conventional vane pump P of the type shown in Figure 1 had problems that because springs 6 needed to be installed inside respective grooves 1 in a quantity that matches that of vanes 2, not only the quantity of the components increased, but the work for installing springs 6 became cumbersome. In addition, in the case of the type shown in Figures 2 and 3, because it had the structure in which vanes 2 were sandwiched between inner circumferential surface 4 of cam ring 5 and outer circumference guide surfaces 9 of ring bodies 8, when the size of vanes 2 in the radial direction was greater than the distance between inner circumferential surface 4 of cam ring 5 and outer circumference guide surfaces 9 of ring bodies 8 due to a manufacturing error, for example, metallic contacts were created between vanes 2 and cam ring 5, resulting in problems that odd metallic noises were generated, and vane pump P was burnt out. On the other hand, when gaps were formed between vanes 2 and cam ring 5 due also to a manufacturing error, it created a problem that the hydraulic oil leaked out through said gaps and flowed backward. As such, in order to maintain the contact state between vanes 2 and cam ring 5, dimensional accuracy of the radius of inner circumferential surface 4 of cam ring 5, the size of

vanes 2 in the radial direction, and the outer diameter of ring bodies 8 had to be improved; which made [the pump] extremely troublesome to manufacture.

The present invention was made from the aforementioned viewpoint, and its purpose is to present a vane pump in which a vane biasing body and elastic protrusions to be placed in elastic contact with base parts of respective vanes are formed into one body, and said vane biasing body is attached to a rotor in order to reduce the number of components and improve the workability while eliminating manufacturing difficulties.

The present invention will be explained in detail below based on application examples shown in attached figures.

In the application example shown in Figures 4 through 6, a nonequilibrium vane pump is shown. Like the conventional technology, said vane pump P is configured with rotor 3 with multiple vanes 2, which are provided at prescribed intervals in the circumferential direction in such a manner that they can slide in the radial direction, and cam ring 5 that surrounds said rotor 3 at prescribed eccentricity e from it; wherein grooves 1 that correspond to the length of vanes 2 in the radial direction are formed on rotor 3, and said grooves 1 have parts that match the width of vanes 2 near their opening parts and enlarged parts 20 in the depth direction that are greater than the width of vanes 2. Then, annular concave parts 22, that almost include enlarged parts 20 of aforementioned grooves 1 around rotary shaft 21 of rotor 3, are formed on both side surfaces of aforementioned rotor 3; and vane biasing bodies 23, that press respective vanes 2 against inner circumferential surface 4 of cam ring 5, are installed inside said concave parts 22.

As shown in Figure 6, said biasing body 23 comprises annular ring main body 24 and elastic protrusions 25 that are provided at the peripheral part of said ring main body 24 in the quantity that matches that of vanes 2 and bent almost at a right angle with respect to ring main body 24. The outer diameter of ring main body 24 is almost equal to the value that is obtained by adding the outer diameter

of said ring main body 14 to [the value obtained by] doubling the size of vane 2 in the radial direction, or almost equal to the inner diameter of cam ring 5; and elastic protrusions 25 are formed in such a manner that they can be transformed elastically in the radial direction of ring main body 24. Then, said vane biasing body 23 is housed inside aforementioned concave part 22 while said elastic protrusions 25 are kept in contact elastically with base parts 10 of respective vanes 2. Under this condition, vane biasing body 23 is maintained concentrically to round inner circumferential surface 4 of cam ring 5; and tip parts 11 of vanes 2 move in and out of grooves 1 of rotor 3 as rotor 3 rotates, whereby they are kept in contact with inner circumferential surface 4 of cam ring 5. Here, said vane biasing bodies 23 move loosely in an eccentric fashion inside concave parts 22 of rotor 3 as rotor 3 rotates, and elastic protrusions 25 move reciprocally inside enlarged parts 20 of grooves 1 in the radial direction.

Therefore, according to the vane pump in accordance with the present application example, respective vanes 2 are sandwiched between inner circumferential surface 4 of cam ring 5 and elastic protrusions 25 of vane biasing bodies 23. However, because elastic protrusions 25 can transform elastically within a certain range, manufacturing errors in terms of the radius of inner circumferential surface 4 of cam ring 5, the size of vanes 2 in the radial direction, and the outer diameter of vane biasing bodies 23 can be absorbed to some extent; and that because respective vanes 2 are pressed against inner circumferential surface 4 of cam ring 5 at a prescribed level of pressure, the contact state between vanes 2 and cam ring 5 can be maintained. In addition, in the present application example, because inner circumferential surface 4 of cam ring 5 is formed into a round shape, and the positions of tip parts 11 of vanes 2 are regulated by inner circumferential surface 4 of cam ring 5, vane biasing bodies 23, which are also formed into a round shape, follow the movements of vanes 2 while moving loosely in an eccentric fashion as a whole. Thus, respective elastic protrusions 25 themselves never transform elastically in different manners when rotor 3 rotates, and said elastic protrusions 25 bias respective vanes 2 in the

radial direction at a certain level of pressure at all times. As a result, fatigue of elastic protrusions 25 can be eliminated as much as possible.

Next, the second application example shown in Figures 7 and 8 will be explained.

Unlike in the first application example, in this application example, annular concave part 22 is formed only on one side of rotor 3, and single vane biasing body 23 is installed inside said concave part 22. Then, elastic protrusions 25 formed at the peripheral part of ring main body 24 of said biasing body 23 have a protruding length that matches the size of vanes 2 in the length direction, and they have a corrugated cross-section with 2 peaks 26 of the same height. Said vane biasing body 23 is housed inside concave part 22 while respective peaks 26 of aforementioned elastic protrusions 25 are placed in contact with base parts 10 of vane 2 elastically.

Therefore, unlike the first application example, according to the vane pump pertaining to the present application example, because respective vanes 2 are supported in the length direction by two peaks 26 of elastic protrusion parts 25, vanes 2 can be prevented from tilting and falling effectively simply by attaching single vane biasing body 23 to rotor 3.

Here, vane biasing body 25 does not have to be the ring-like shape as long as elastic protrusion parts 25 are provided at the peripheral part, and the design can be changed arbitrarily as a matter of course. Furthermore, although elastic protrusion 25 has a corrugated cross-section with two peaks 26 in the second application example, it dose not impose any restriction, and it may have a corrugated cross-section with three or more peaks 26, or it does not have to have a corrugated cross-section.

As explained above, according to the vane pump of the present invention, because the elastic protrusion parts to be placed in contact with the base parts of the respective vanes are formed integrally with the vane biasing body at the peripheral part, and said vane biasing body is attached to the side surface part of the rotor so as to press the vanes against the inner circumferential surface of the cam ring, unlike in the past, there is no need to install any biasing rings for the respective vanes. As such, the

quantity of the components can be reduced, and the vane biasing body can be attached through a single operation, so that the assembling workability can be improved significantly. In addition, although it is assumed that the present invention has a structure in which the respective vanes are sandwiched between the inner circumferential surface of the cam ring and the elastic protrusions of the vane biasing body, because the elastic protrusions have certain elasticity, a certain degree of manufacturing errors in terms of the radius of the inner diameter of the cam ring, the size of the vanes in the radial direction, and the outer diameter of the vane biasing bodies can be absorbed during the assembling, so that the vanes can be pressed against the inner circumferential surface of the cam ring at a certain level of pressure at all times. Thus, unlike in the past, odd metallic noises generated when the vane pump is in operation due to manufacturing errors and backflow of the hydraulic oil never occur, so that conventional difficulties in manufacturing that are associated with the improvement of dimensional precision can be eliminated.

Brief description of the figures

Figure 1 is a cross-sectional view of an example conventional vane pump, Figure 2 is a cross-sectional view of another example conventional vane pump, Figure 3 is a cross-sectional view along the III-III line in Figure 2, Figure 4 is a cross-sectional view of a first application example of the vane pump pertaining to the present invention, Figure 5 is a cross-sectional view along the V-V line in Figure 4, Figure 6 is a perspective view showing details of the vane biasing body shown in Figure 4, Figure 7 is a cross-sectional view of a second application example of the vane pump pertaining to the present invention (equivalent to a cross-sectional view of the cardinal part along the V-V line in Figure 4), and Figure 8 is a perspective view showing details of the vane biasing body shown in Figure 7.

Explanation of the symbols

P	Vane pump
1	Groove part
2	Vane
3	Rotor
4	Inner circumferential surface
5	Cam ring
10	Base part
11	Tip part
23	Vane biasing body
25	Elastic protrusion piece
26	Peak part

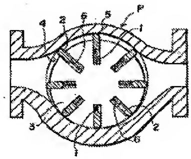

Figure 1

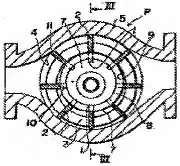

Figure 2

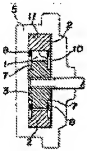

Figure 3

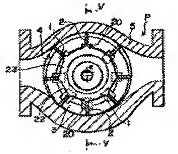

Figure 4

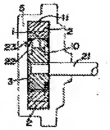

Figure 5

Figure 6

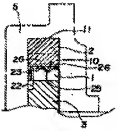

Figure 7

Figure 8